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Are Drone Strikes Effective in Afghanistan and Pakistan? On the Dynamics of Violence between the United States and the Taliban

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Abstract

Strikes by unmanned aerial vehicles, or drones, have been the primary weapon used by the United States to combat the Taliban and Al-Qaeda in Afghanistan and Pakistan. This paper examines the dynamics of violence involving drone strikes and the Taliban/Al-Qaeda in Afghanistan and Pakistan from January 1, 2007 to September 30, 2011. We find that drone strikes have a stronger impact on Taliban/Al-Qaeda violence in Pakistan than in Afghanistan and that these results are robust to examining different time periods and lag structures. We also examine the impact of successful and unsuccessful drone strikes (which did or did not succeed in targeted killing of a militant leader) on terrorist attacks by the Taliban. We find strong effects of unsuccessful drone strikes on Taliban violence in Pakistan, suggesting important vengeance and deterrent effects.

JEL codes: C32, D74

Keywords: Time Series Models, Conflict, Drones

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Attacks by unmanned aerial vehicles, or drones, have been one of the main policies used by the United States to carry out targeted killings of terrorists in Afghanistan and Pakistan. The perceived success of these attacks led to a substantial increase in the use of drones as a strategic tool of the U.S. Central Intelligence Agency and its military around the globe.[1] In Afghanistan and Pakistan, the targets are typically Taliban and Al-Qaeda militant leaders in the Federally Administered Tribal Areas (FATA) of Northwest Pakistan. Although drone strikes have killed important Taliban leaders, their use is unpopular in Pakistan due to the "collateral" civilian casualties often associated with them, as well as possible retaliation against civilians by the Taliban. For example, after a terrorist attack on a police academy in Lahore in March 2009 in which eighteen people were killed, Baitullah Mehsud (then leader of the Tehrik-e-Taliban Pakistan) stated that the attack was "in retaliation for the continued drone strikes by the United States in collaboration with Pakistan on our people."[2]

While the primary strategic goal of the U.S. in using drone strikes in the FATA has been to incapacitate Al-Qaeda and eliminate its capacity to attack the U.S., its secondary goals are surely also to reduce terrorist attacks by the Taliban and Al-Qaeda against U.S. and NATO forces in Afghanistan and to assure security of Pakistan's nuclear weapons. The long-run chances of success for the U.S. and its allies in the region are likely to be diminished by continued reprisal terrorist attacks by the Taliban and Al-Qaeda against Afghanis and Pakistanis. This paper examines the extent to which drone strikes affect subsequent violence by the Taliban and Al-Qaeda – in particular, whether the number and incidence of terrorist attacks increases (through in retaliation and reprisal) or decreases (due to incapacitation and deterrence). Following Jaeger and Paserman's (2006, 2008, 2009) work on the Second Intifada in Israel, we exploit daily variation in drone strikes and terrorist attacks by the Taliban and Al-Qaeda in Afghanistan and Pakistan from January 1, 2007 to September 30, 2011 to estimate vector autoregressions of the dynamic patterns of violence. We also empirically test whether there is co-ordination in Taliban violence across the border in Afghanistan and Pakistan.[3]

[1] *Washington Post*, 28 December 2011,"Under Obama, An Emerging Global Apparatus for Drone Killing," http://www.washingtonpost.com/national/national-security/under-obama-an-emerging-global-apparatus-for-drone-killing/2011/12/13/gIQANPdILP_story.html, last accessed 29 August 2017.

[2] BBC, 31 March 2009, "Lahore 'was Pakistan Taleban op'," http://news.bbc.co.uk/2/hi/south_asia/7973540.stm, last accessed 29 August 2017.

[3] The Taliban are composed of Pashtun tribes located in the border areas of Afghanistan (south and south east areas) and Pakistan (north and north west areas). While there are different factions within the Taliban, a general perception is that there is co-ordination in Taliban violence across the two countries.

We examine the efficacy of U.S. counter-terrorism "stick" (drone strikes) to combat the Taliban and Al-Qaeda, and examine whether the use of drone strikes affects terrorist actions in Afghanistan, where the U.S. is directly engaged with the Taliban, and in Pakistan, where, except for the FATA, the U.S. is not directly engaged with the Taliban. We find that there are stronger effects of drone strikes on subsequent Taliban and Al-Qaeda attacks in Pakistan than there are in Afghanistan. In Pakistan, the probability of a terrorist attack increases in the first week after a drone strike. The impact is negative in the second week following a drone strike, when we examine the number of terrorist attacks by the Taliban and Al-Qaeda. This suggests an intertemporal re-allocation of terrorist attacks in Pakistan, which are pushed forward by the Taliban in response to drone strikes. Our results are qualitatively robust to examining different time periods and lag structures.

We contribute to the literatures on counterterrorism measures and asymmetric conflict by using a vector autoregressive approach. Such an approach has been used previously to examine policies to combat transnational terrorism (Enders and Sadler 1993). More closely related to our paper are those that look at the violence within one country, such as Hanson and Schmidt (2011), who examine how offensive operations by the coalition of forces operating in Iraq disrupted insurgent activity, but find that such actions may only have led to a subsequent increase in coalition fatalities, and the several papers by Jaeger and Paserman (2006, 2008, 2009), who examined the dynamics of violence between the Israeli military and Palestian groups, and specifically the effectiveness of targeted killings of Palestinian leaders. Like our papers, these latter papers examine the "stick" (Frey 2004) of specific violent policies within a conflict between insurgent groups and an organized military. Unlike the Iraq and Palestinian-Israeli conflicts, however, we are examining terrorist actions that are not directed against the military force in question, but rather against (potentially) civilians in third-party states (Afghanistan and Pakistan).

1 Background

The Taliban consist of ethnic Pashtun tribes found along the border areas of Afghanistan and Pakistan. While the Taliban in Afghanistan are a fairly monolithic group, in Pakistan there are several militant groups which are collectively referred to as Taliban. The most important of these is the Tehrik-e-Taliban Pakistan which acts as an umbrella movement for various commanders across the South Waziristan area of the FATA and has been particularly active in carrying out

terrorist attacks within Pakistan. The Haqqani faction, which operates in the North Waziristan agency of FATA, is more actively involved in terrorist attacks in Afghanistan.

The recent past has been characterized by periods of conflict and of calm between the Taliban and the Pakistan military, which first entered the FATA in June 2002. Since the FATA have traditionally been semi-autonomous, this was the first time since Pakistan's independence in 1947 that the Pakistan government had directly interfered there. The first drone strike in the FATA by the U.S. was reported in June 2004. Between 2004 and 2005, the Pakistan military was directly engaged with the Taliban in the northern areas. In September 2006 Pakistan signed the Waziristan Accord, a peace deal with the Taliban, which ended in July 2007 when the Pakistan military laid siege to the Red Mosque (Lal Masjid) in the capitol city of Islamabad in which Islamic militants were holed up. Following the Red Mosque siege there was a sharp escalation in terrorist attacks by the Taliban in Pakistan. The number of drone strikes by the U.S. targeting Taliban and militant leadership in Pakistan continued during this period and increased in frequency. From January to May 2008 and September to October 2008 the Pakistan military was again involved in direct military offensives against the Taliban. Another peace agreement followed between February and April 2009 known as the Malakand Accord. Subsequently, there were further military offensives by the Pakistan military against the Taliban in May 2009 and between October to December 2009. In August 2009 a drone strike by the U.S. succeeded in killing Baitullah Mehsud, then leader of the Tehrik-e-Taliban Pakistan, who was succeeded by Hakimullah Mehsud. In May 2011 Osbama bin Laden was killed in a raid in the city of Abbottabad, Pakistan, which likely limited the subsequent operational capabilities of Al-Qaeda.

2 Data

We use the Worldwide Incidents Tracking System (WITS) database collected by the National Counter Terrorism Center as our source of terrorist incidents with perpetrators identified as Taliban or Al-Qaeda in Afghanistan and Pakistan from January 1, 2007 to September 30, 2011.[4] As a robustness check we examine whether the incidents reported by the WITS database are consistent with other databases on terrorist incidents such as the Global Terrorism Database maintained by the National Consortium for the Study of Terrorism and Responses to Terrorism

[4]The WITS was formerly located at https://wits.nctc.gov/. The WITS was maintained by the National Counterterrorism Center but was discontinued in April 2012. We last downloaded data on 17 January 2012.

at the University of Maryland and the RAND Database of Worldwide Terrorism Incidents.[5] Although we do not find a perfect correlation in the number of terrorist attacks carried out by the Taliban and Al-Qaeda in the different databases, we did find the WITS database to have the best coverage of such incidents. For instance, we found an almost perfect correlation between the suicide attacks attributed to the Taliban and Al-Qaeda in WITS with a proprietary administrative data source that documented such attacks, while the other databases entirely miss large numbers of such incidents.

Incidents in the WITS database consist of all "incidents in which sub-national or clandestine groups or individuals deliberately or recklessly attacked civilians or noncombatants (including military personnel and assets outside war zones and war like settings)." An important consideration concerns what constitutes a "terrorist act." Those attacks initiated and carried out by terrorists are included in the database, while spontaneous hate crimes and genocides are not. A potential problem is that it is sometimes difficult to separate crime from terrorist acts. In general, a crime committed in support of terrorism is included in the database, but not otherwise.

Data on incidence and fatalities arising from drone strikes comes from the New America Foundation, which collects and provides data on incidence, day, location, fatalities (including those of militant leaders), intended target and source of information.[6] The sources from which the data are compiled include media organizations such as the New York Times, Washington Post and Wall Street Journal, news services and networks such as the Associated Press, Reuters, Agence France-Presse, CNN and BBC, English language media from Pakistan such as the Daily Times, Dawn and the News and GEO TV.

The annual frequency of drone strikes by the U.S. and terrorist attacks by the Taliban and Al-Qaeda between 1 January 2005 and 30 September is shown in Table 1. Both drone strikes and overall terrorist attacks clearly increased in this period. The success rate of drone strikes declined substantially, however, as did the share of suicide attacks in terrorist actions.

In Figure 1 we show the monthly number of terrorist attacks by the Taliban and Al-Qaeda in Afghanistan and Pakistan as well as the monthly number of drone strikes. Vertical lines indicate important time periods of the conflict: the Red Mosque siege of July 2007 in Pakistan, the start of the Obama administration in office from February 2009, the Malakand accord from

[5]The Global Terrorism Database is available at http://www.start.umd.edu/gtd/ and the RAND data are available at http://www.rand.org/nsrd/projects/terrorism-incidents.html, both last accessed on 29 August 2017.

[6]See https://www.newamerica.org/in-depth/americas-counterterrorism-wars/pakistan/, last accessed 29 August 2017.

February to April 2009, the four different military campaigns by the Pakistan military, and Osama bin Laden's death in May 2011. The frequency of terrorist attacks by the Taliban and Al-Qaeda in Pakistan clearly increased after the Red Mosque siege in 2007. There were large numbers of attacks in 2008 and 2009 but fewer in 2010 and 2011, after the August 2009 killing of Baitullah Mehsud in a drone strike. In Afghanistan, the number of terrorist attacks by the Taliban and Al-Qaeda is about twice as high as in Pakistan, increasing until 2011, when there is a decline. There is also seasonal variation in terrorist attacks by the Taliban and Al-Qaeda in Afghanistan, with the highest number of attacks occurring during the summer months. Drone strikes are fewer in number than terrorist attacks, but they increased after the beginning of 2008. There was also an increase in the number of drone strikes after the Obama administration took office in 2009, and again in 2010.

Terrorist attacks also vary spatially and in Figure 2 we show the distribution of the aggregate number of terrorist attacks by the Taliban and Al-Qaeda in Afghanistan across its thirty five states between 1 January 2007 and 30 September 30 2011. The geographical concentration of terrorist attacks is, not surprisingly, in areas dominated by the Taliban in the south and south east of Afghanistan. Similarly, Figure 3 shows the spatial distribution of the aggregate number of terrorist attacks in Pakistan across its four states in the same period. Most of the terrorist attacks are geographically concentrated in the north and north west of the country, close to the FATA where the drone strikes take place.

Because Al-Qaeda has directly claimed responsibility for a very small number of terrorist attacks (nine incidents in Pakistan and none in Afghanistan), in the rest of the paper we will refer to the "Taliban" as the terrorist actor in the analysis.

3 Empirical Strategy

To examine the effects of drone strikes on Taliban violence in Afghanistan and Pakistan, we posit a simple vector autoregressive model similar to that of Jaeger and Paserman (2008). We are particularly interested in whether drone strikes reduce subsequent Taliban violence. For the Taliban in Afghanistan, we estimate reaction functions of the form

$$T_t^A = f_i(D_{t-1}, ..., D_{t-p}, T_{t-1}^P, ..., T_{t-p}^P, T_{t-1}^A, ..., T_{t-p}^A, X_t), \tag{1}$$

and in Pakistan,

$$T_t^P = f_i(D_{t-1}, ..., D_{t-p}, T_{t-1}^A, ..., T_{t-p}^A, T_{t-1}^P, ..., T_{t-p}^P, X_t), \tag{2}$$

where T_t^A, T_t^P and D_t represent period t terrorist attacks by the Taliban in Afghanistan, terrorist attacks by the Taliban in Pakistan and drone strikes, respectively, p is the maximum number of lags that have a non-zero effect and X_t is a vector of variables that may shift the reaction function up or down or change the parameters of the reaction function. We also estimate the reaction functions for the United States government in its exercise of drone strikes in the FATA:

$$D_t = f_i(T_{t-1}^A, ..., T_{t-p}^A, T_{t-1}^P, ..., T_{t-p}^P, D_{t-1}, ..., D_{t-p}, X_t). \tag{3}$$

Drone strikes are likely based on intelligence gathered on high value Taliban and terrorist targets. To the extent that this intelligence gathering (and the timing of drone strikes) is independent the unobserved determinants of Taliban actions, our estimates of these parameters in the Taliban reaction functions can be viewed as the causal effects of drone strikes on Taliban actions (Granger 1969). We have also included an exhaustive set of controls to mitigate concerns of omitted variable bias, which we describe in the next section.

In both of the Taliban equations, we pay particular attention to the signs of the coefficients. We hypothesize that drone strikes can lead to subsequent reductions in terrorist activity if they incapacitate the Taliban or deter the Taliban from further violence. On the other hand, drone strikes may induce further violence through vengeance. If the coefficients on the $D_{t-1}, \ldots, D_{t-p}$ variables are negative, then the incapacitation and deterrence effects dominate (on net) while if they are positive then the vengeance effect dominates (on net). We also estimate a specification (in Section 6) in which we separate successful drone strikes (ones which killed a militant leader) from those which were not successful (one which did not kill a militant leader). We expect the coefficients associated with successful drone strikes to capture the incapacitation, deterrence and vengeance effects while the coefficients associated with unsuccessful drone strikes potentially capture the deterrence and vengeance effects only, provided of course that unsuccessful drone strikes do not have any impact on the operational capabilities of the Taliban. Our empirical strategy also allows us to test whether there is any co-ordination in Taliban violence across the border in Afghanistan and Pakistan by exploiting geographic variation in drone strikes, and examine whether drone strikes in Pakistan affect terrorism in Afghanistan and in Pakistan.

4 Baseline Results

We estimate the reaction functions defined by equations (1) and (2) by estimating OLS regressions where we correct for both heteroscedasticity and autocorrelation in the disturbance terms using Newey-West standard errors. We choose a lag length of twenty one days in our baseline estimation.[7] We estimate two different specifications: in the first specification (which we refer to as the incidence specification), T_t^A, T_t^P and D_t are dummy variables for whether there was any terrorist attack by the Taliban in Afghanistan, by the Taliban in Pakistan or whether there was any drone strike on day t. In the second specification (which we refer to as the levels specification), T_t^A, T_t^P and D_t are the number of terrorist attacks by the Taliban in Afghanistan, by the Taliban in Pakistan and the number of drone strikes on day t. In each of the tables, panel A shows the impact of drone strikes on the outcome variables, panel B shows the effect of terrorist attacks by the Taliban in Afghanistan on the outcomes, and panel C shows the effect of terrorist attacks by the Taliban in Afghanistan on the outcomes.

All regressions include day of week indicators and an indicator for the months in the Muslim calendar with traditionally reduced fighting (Muharram, Dhu al-Qidah, Dhu al-Hijjah, and Rajab). We also include a linear time trend in all regressions.[8] We also include a series of indicators to control for the different periods in the conflict that we outlined above: a) after the Red Mosque siege of 4 July 2007, marking the end of the Waziristan Accord, a peace deal signed by Pakistan with the Taliban in September 2006, and which triggered widespread terrorist violence within Pakistan, b) after the Obama administration took office from 21 January 2009, as there was a clear policy shift towards greater use of drone strikes, c) during the time of the Malakand accord from 15 February to 13 April 2009, when it was an anticipated that the Pakinstani army would cede control of the Swat district to the Taliban, d) after Osama bin Laden was killed in a raid in Abbottabad on 2 May 2011 because bin Laden's death influenced the institutional capabilities of Al-Qaeeda and potentially also the Taliban, and e) dummy variables for each of four military campaigns undertaken by the Pakistan military against the insurgents.[9] These military campaigns likely shifted the Taliban's underlying agenda, particularly with regard to Pakistan, and potentially influenced the level of drone strikes. As such these are important

[7] We also estimated but do not report a negative binomial specification with robust standard errors. We find that our results are qualitatively quite similar. These results are available from the authors on request.

[8] We have also produced results that do not control for trend or control for a quadratic trend. The results are qualitatively similar to the ones we present in the paper and are available from the authors by request.

[9] These military campaigns occur from 1 January to 31 May 2008, from 23 September to 31 October 2008, from 1 to 31 May 2009 and from 18 October to 12 December 2009.

omitted variables that we control for in our empirical analysis. We show the coefficients for these variables in panel D in the tables.

We present estimation results of the reaction function of the Taliban in Afghanistan in Table 2. The first set of columns gives the estimation results for the incidence specification while the second set of columns gives estimates for the levels specification. The results suggest that drone strikes by the U.S. do not have an impact on terrorist attacks by the Taliban in Afghanistan in the incidence specification, but have some impact in the levels specification in the form of reduced number of attacks 21 days after a drone strike by the U.S. In the incidence specification, the 21 coefficients on lagged drone strikes are not jointly statistically significant in the incidence specification (at the 5% level), but are are jointly significant at the 5% level in the levels specification. The sum of coefficients on 21 lags of terrorist attacks by the Taliban in Pakistan is not statistically significant for both the incidence and levels specifications.

Estimates of the reaction functions of the Taliban in Pakistan are shown in Table 3, which is structured in the same way as Table 2. We find stronger effects of drone strikes on subsequent Taliban violence in Pakistan than in Afghanistan, although the sign of these effects are somewhat mixed and suggest a potential re-allocation of attacks moved forward by the Taliban in response to a drone strike. We find that a terrorist attack by the Taliban in Pakistan is 9.0% more likely to occur five days after a drone strike and 7.4% more likely to occur six days after a drone strike and these effects are statistically significant at the 1% and 2.5% level of significance. There are also 0.113 fewer terrorist attacks twelve days after a drone strike. This effect is significant at the 1% level. When we test for joint significance of all lags of drone strikes on terrorist attacks by the Taliban in Pakistan we find that these lags are jointly significant (at the 5% level) in explaining such attacks in both the incidence and levels specifications. We also find that Taliban violence in Pakistan is negatively associated with Taliban violence in Afghanistan; 0.020 fewer terrorist attacks occur sixteen days after one terrorist attack in Afghanistan (not shown in the table). In a test of joint significance of all lags of terrorist attacks in Afghanistan we find these lags to be jointly significant in the levels specification but not in the incidence specification.

We present estimates of impact of terrorist attacks in Afghanistan and Pakistan on drone strikes in Table 4. We do find a statistically significant and generally positive relationship between terrorism in Afghanistan and drone strikes. The relationship between terrorism and drone strikes in Pakistan is less strong. In the incidence specification, the 21 lags are not jointly statistically significant nor is the sum of coefficients. In the levels specification, the evidence

is mixed, with two positive and two negative statistically significant coefficients. Identification of the reaction functions for the Taliban rests on the assumption that there are no unobserved factors that determine both drone strikes and terrorist attacks, conditional on the lagged values of each. The results from the drone strike reaction function suggests that controlling for a rich set of other covariates is important, which motivates our inclusion of different time periods, as well as the number of U.S. troops in all regression. In the rest of the paper, we focus on the Taliban reaction functions in Afghanistan and Pakistan.

We next carry out a number of robustness checks to determine whether these baseline results persist when we when we vary the lag structure, the level of aggregation, and focus on lethal Taliban attacks.[10]

5 Robustness Checks

5.1 Lag Structures

Although we chose the lag length for the results in Tables 2 and 3 based on likelihood ratio statistics, it is well-known that Granger causality results to the number of lags included in the analysis. To check the robustness of our results, in Table 5, we present p-values for tests of joint significance of drone strikes and the sum of the coefficients on drone strikes for the Taliban reaction functions in Afghanistan and Pakistan, using lags from one to ten weeks (seven to seventy days, respectively). For lag lengths of 35 days or less, the results are generally qualitatively similar to those in Tables 2 and 3. Increasing the number of lags does lead to the more frequent rejection of the null of no effect for the number of attacks in Afghanistan as well as in Pakistan. The results in the incidence specification are generally qualitatively similar to those in Table 2 and 3 regardless of the number of lags. Qualitatively our conclusion that drone strikes have a stronger impact on terrorism in Pakistan than in Afghanistan continues to hold.

5.2 Time Aggregation

In our baseline specification, we examined short-run (3 week) dynamics of violence and found that there is less effect of drone strikes on Taliban actions in Afghanistan and a larger and significant, but somewhat mixed, effect on Taliban actions in Pakistan. Unlike the Palestini-

[10] In results available from the authors by request, we have also estimated the baseline specifications only for the 2008-2010 period, when drone strikes began to be used in significant numbers, as well as the period after the Red Mosque Siege in July 2007, which was a triggering event for elevated terrorist activity. The results are qualitatively similar to those presented in Tables 2 and 3.

ans in Israel, we expect that the Taliban has somewhat greater ability to act, particularly in Afghanistan. It is possible, however, that using high-frequency data masks some longer-term reaction (or deterrence) of Taliban actions. To explore this issue, in Table 5 we estimate models similar to those in Tables 2 and 3, but using weekly and monthly aggregation of the data. We find no significant effects of drone strikes on Taliban violence in Pakistan when we aggregate to weeks, although the significant effect returns at a monthly frequency. This is perhaps consistent with a temporal re-allocation of attacks by the Taliban in response to a drone strike. We find also find an effect only at a monthly frequency in Afghanistan. In this regression, the coefficient on drone strikes is negative and highly significant – indicating that drone strikes may have a deterrence or incapacitation effect on longer-run violence in Afghanistan.

5.3 Outcome Measure

We have thus far measured intensity of Taliban actions only by using the incidence or number of terrorist attacks. To explore this issue further, we now look at two somewhat different outcomes by examining either those Taliban actions that resulted in at least one fatality or only those in which a suicide attack occurred. We use data on incident description and fatalities in WITS to construct the incidence and number of lethal and suicide terrorist attacks by the Taliban in Afghanistan and in Pakistan. We return to the model with 21 lags from Tables 2 and 3.

Tests of joint significance are reported in Table 7. The effect of drone strikes on both lethal and suicide attacks in Afghanistan is similar to the baseline specification, little or no effect on either incidence or levels. The results in Pakistan are somewhat more mixed, where we find that drone strikes have a jointly significant (at the 5% level) effect on lethal attacks, and on incidence of suicide attacks but no significant effect on level of suicide attacks. This is consistent with the evidence from the Palestinian-Israeli conflict, where Jaeger and Paserman (2009) found that Israeli counter-terrorism measures had little predictive power for suicide attacks, perhaps because suicide attacks take longer to organize than other types of violence and require elements of surprise in order to be effective.

6 Extensions

6.1 Haqqani and Mehsud Factions of the Taliban

We have treated the Taliban as a monolithic group, with the only distinction being in terrorist attacks carried out across the border in either Afghanistan or Pakistan. Two distinct factions within the Taliban have been targeted by drone strikes in recent years, however, and these factions have a base of operations in different parts of the FATA. The Haqqani faction of the Taliban is based in North Waziristan while the Tehrik-e-Taliban Pakistan (thereafter referred to as the Mehsud faction of the Taliban) is based in South Waziristan areas of FATA. Drone strikes carried out in North Waziristan target the Haqqani faction while drone strikes in South Waziristan target the Mehsud faction. The Haqqani faction of the Taliban carries out terrorist attacks in parts of Afghanistan while the Mehsud faction carries out terrorist attacks in the FATA areas of Pakistan. The two groups may have different strategic aims given their sphere of influence, and we estimate reaction functions for each faction by using geographical information on terrorist attacks and drone strikes. We estimate the reaction function for the Haqqani faction of the Taliban by using data on terrorist attacks by the Taliban in parts of Afghanistan which are believed to be the Haqqani areas of combat operations; these include the eastern states of Khost, Paktia, Paktika, Ghazni, Logar, Wardak, and Kabul in Afghanistan. We estimate reaction functions for the Mehsud faction of the Taliban by using data on terrorist attacks by the Taliban in the FATA areas of Pakistan which are believed to be the Mehsud areas of combat operations.

For the Haqqani faction of the Taliban the reaction functions we estimate are of the form

$$T_t^{Haqqani} = f_i(D_{t-1}^{Haqqani}, ..., D_{t-p}^{Haqqani}, T_{t-1}^{Haqqani}, ..., T_{t-p}^{Haqqani}, X_t) \tag{4}$$

where $T_t^{Haqqani}$ represents terrorist attacks by the Taliban in the eastern states of Khost, Paktia, Paktika, Ghazni, Logar, Wardak, and Kabul in Afghanistan at time t and $D_t^{Haqqani}$ represents drone strikes in North Waziristan at time t. As above, p is the maximum number of lags that have a non-zero effect and X_t is a vector of variables that may shift the reaction function up or down or change the parameters of the reaction function.

Our empirical strategy is the same as before, with estimation of empirical reaction functions by OLS with twenty-one lags and Newey-West standard errors. The estimation results are re-

ported in Table 8, with the first set of columns giving the estimation results from the incidence specification and the second set of columns giving the estimation results from the levels specification. A terrorist attack in the Haqqani areas in eastern Afghanistan is 8.3% less likely to occur seventeen days after a drone strike in North Waziristan, indicating the incapacitation/deterrence effect dominates the vengeance effect, although this result is statistically significant at the 5% level. Overall, there does not appear to be a strong effect of drone strikes in North Waziristan on attacks by the Haqqani faction in Afghanistan (neither the sum of the coefficients on lags of drone strikes nor these coefficients jointly are statistically different from zero). In results that are not reported, the incidence and number of terrorist attacks by the Haqqani faction is reduced during the Muslim months in which fighting is traditionally forbidden.

For the Mehsud faction of the Taliban the reaction functions we estimate are of the form

$$T_t^{Mehsud} = f_i(D_{t-1}^{Mehsud}, ..., D_{t-p}^{Mehsud}, T_{t-1}^{Mehsud}, ..., T_{t-p}^{Mehsud}, X_t) \tag{5}$$

where T_t^{Mehsud} represents terrorist attacks by the Taliban in the FATA areas of Pakistan at time t and D_t^{Mehsud} represents drone strikes in South Waziristan at time t. As before, p is the maximum number of lags that have a non-zero effect and X_t is a vector of variables that may shift the reaction function up or down or change the parameters of the reaction function.

The estimation results are reported in Table 9, with the first set of columns giving the estimation results from the incidence specification and the fourth column giving the estimation results from the levels specification. We find that a terrorist attack by the Mehsud faction in FATA is 12.7% more likely eleven days after a drone strike in South Waziristan but that it is 11.6% less likely fourteen days after a drone strike in South Waziristan. There are also 0.119 fewer terrorist attacks fourteen days after a drone strike (everything else constant). Overall, there appear to be vengeance effects but also large deterrent/incapacitation effects occurring in the second week after a drone strike for the Mehsud faction of the Taliban. Coefficients on lags of drone strikes are jointly statistically significant from zero in both the incidence and levels specification. Unlike the Haqqani faction, the incidence and number of terrorist attacks by the Mehsud faction are not affected during the muslim months in which fighting is traditionally forbidden.

6.2 Successful and Unsuccessful Drone Strikes

Jaeger and Paserman (2009) found differential effects of successful and unsuccessful assassination attempts of Palestinian leaders. We employ a similar strategy here by exploiting information on whether or not a particular drone strike was successful in eliminating a militant leader. By decomposing the drone strikes into those which were successful and not successful, we are able to investigate the individual deterrence and incapacitation effects of drone strikes on terrorist violence.

For the Taliban in Afghanistan the reaction functions we estimate are of the form,

$$T_t^A = f_i(D_{t-1}^S, ..., D_{t-p}^S, D_{t-1}^U, ..., D_{t-p}^U, T_{t-1}^P, ..., T_{t-p}^{Pakistan}, T_{t-1}^A, ..., T_{t-p}^A, X_t) \tag{6}$$

where D_t^S and D_t^U represent drone strikes that were successful and that were not successful in killing a militant leader at time t, respectively. The estimation results are reported in table 10. We find that a terrorist attack in Afghanistan is 10.7% more likely five days after a successful drone strike and 5.3% more likely five days after an unsuccessful drone strike. At the same time there are 0.463 fewer terrorist attacks thirteen days after a successful drone strike and 0.335 fewer terrorist attacks twenty one days after an unsuccessful drone strike. There do not appear to be differential impacts of successful and unsuccessful drone strikes on terrorist attacks by the Taliban in Afghanistan.

For the Taliban in Pakistan the reaction functions we estimate are of the form,

$$T_t^P = f_i(D_{t-1}^S, ..., D_{t-p}^S, D_{t-1}^U, ..., D_{t-p}^U, T_{t-1}^A, ..., T_{t-p}^A, T_{t-1}^P, ..., T_{t-p}^P, X_t) \tag{7}$$

with the variables defined as above. The estimation results are reported in table 11. We find that a terrorist attack in Pakistan is 17.7% less likely to occur three days after a successful drone strike. At the same time we find that a terrorist attack is 9.7% and 7.5% more likely to occur five and six days after an unsuccessful drone strike, and that a terrorist attack is 7.5% and 8.7% less likely to occur twelve and thirteen days after an unsuccessful drone strike. There are 0.283 fewer terrorist attacks in Pakistan fifteen days after a successful drone strike, 0.099 more terrorist attacks in Pakistan six days after an unsuccessful drone strike and 0.121 fewer terrorist attacks in Pakistan twelve days after an unsuccessful drone strike (all else constant). These effects are statistically significant. Because all of the statistically significant coefficients

on successful drone strikes are negative, it appears that there is an incapacitation effect of the Taliban due to a lost militant leader. The mixed pattern of coefficients on unsuccessful drone strikes indicates that the intertemporal allocation of terrorist attacks that we noted earlier is in response to these kinds of drone strikes, rather than drone strikes which are able to take out a militant leader.

7 Conclusion

We examine the dynamics of the conflict involving the Taliban across Afghanistan and Pakistan and the use of drone strikes as a counter-terrorism policy to combat the Taliban. We test the following hypotheses: do the Taliban increase or decrease terrorist attacks following drone strikes which target militant leaders of the Taliban? How do the impacts differ across the border in attacks carried out by the Taliban in Afghanistan and attacks carried out by the Taliban in Pakistan? Is there a cycle of violence associated with the use of drone strikes by the United States government in Pakistan? Does U.S. policy to combat the Taliban and Al-Qaeda (in the form of drone strikes) have some impact on terrorist activities of the Taliban in neighboring Afghanistan?

We find that there is little significant impact of drone strikes on Taliban attacks in Afghanistan but that there is a significant impact of drone strikes on Taliban attacks in Pakistan. This impact varies from a positive vengeance effect in the first week following a drone strike to a negative deterrent/incapacitation effect in the second week following a drone strike, when we examine the incidence of terrorist attacks by the Taliban. The impact is negative in the second week following a drone strike, when we examine the number of terrorist attacks by the Taliban.

We also examine whether drone strikes in North Waziristan have an impact on Taliban violence in parts of Afghanistan under the control of the Haqqani faction of the Taliban. We examine whether drone strikes in South Waziristan have an impact on Taliban violence in the Federally Administered Tribal Areas under the control of the Mehsud faction of the Taliban. We find some vengeance effects of drone strikes on violence by the Mehsud faction but also deterrent/incapacitation effects of drone strikes on violence by both the Haqqani and Mehsud factions of the Taliban. We estimate the differential effects of successful and unsuccessful drone strikes (which kill and do not kill a militant leader) on Taliban violence in Afghanistan and in Pakistan. We find strong positive and negative impacts of unsuccessful drone strikes on Taliban

violence in Pakistan, showing a possible reallocation of attacks over time in response to these kinds of strikes.

The differential effects of drone strikes in Pakistan, where they appear to increase terrorist violence, and in Afghanistan, where they appear to have a smaller effect, if any, are likely driven by the presence of the U.S. military in Afghanistan. Terrorist attacks there may be more likely to reveal operational information about the Taliban that would make it easier for the U.S. military or drones to target. It also seems possible to us that terrorism in Pakistan would be more likely to pay off in terms of shifting policy there than in Afghanistan, where the government in this period was substantially dependent on U.S. aid. Terrorism against civilians may change the "hearts and minds" of the Pakistani population if they perceive it is a consequence of the Pakistani government's cooperation with the United States. The benefits (to the Taliban) of terrorism in Pakistan may therefore be greater, particularly if those actions are rhetorically linked to drone strikes, as Baitullah Mehsud claimed in 2009.

Our work has relevance for U.S. drones policy in Pakistan as well as possible use of the policy in other parts of the world. While drone strikes may be an effective policy for reducing the threat of terrorism against the U.S. homeland, there may be unintended consequences closer to where the drone strikes take place. Terrorist groups may decide not (or be unable) to retaliate against the U.S., but may choose to retaliate against local regimes that are perceived to be friendly to the U.S. In the case of Pakistan, retaliation by the Taliban against civilians in Pakistan may have have political consequences there that could lead to deterioration of U.S.-Pakistani relations.

We have also also provided empirical evidence of deterrence effects of a specific counter-terrorism policy across different factions of a larger group with a common ideology (the Taliban). We find that these effects can vary across the different factions, with vengeance effects being stronger for some factions than for others. Our most important finding is that drone strikes matter, but primarily for Taliban violence in Pakistan. There is less of an effect of drone strikes on Taliban violence across the border in Afghanistan.

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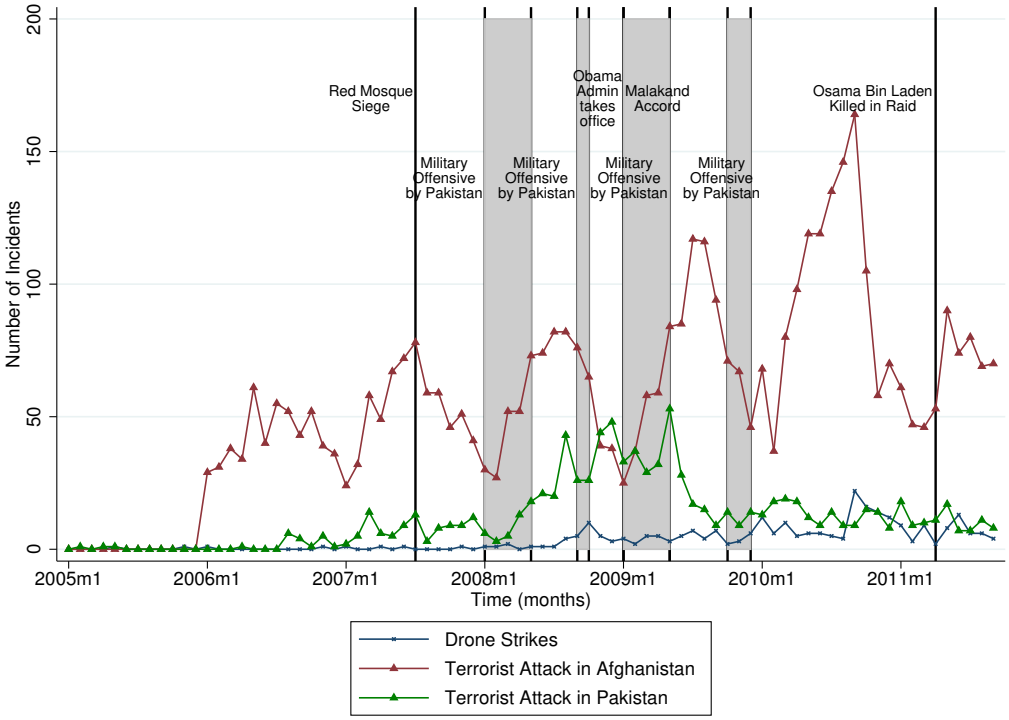
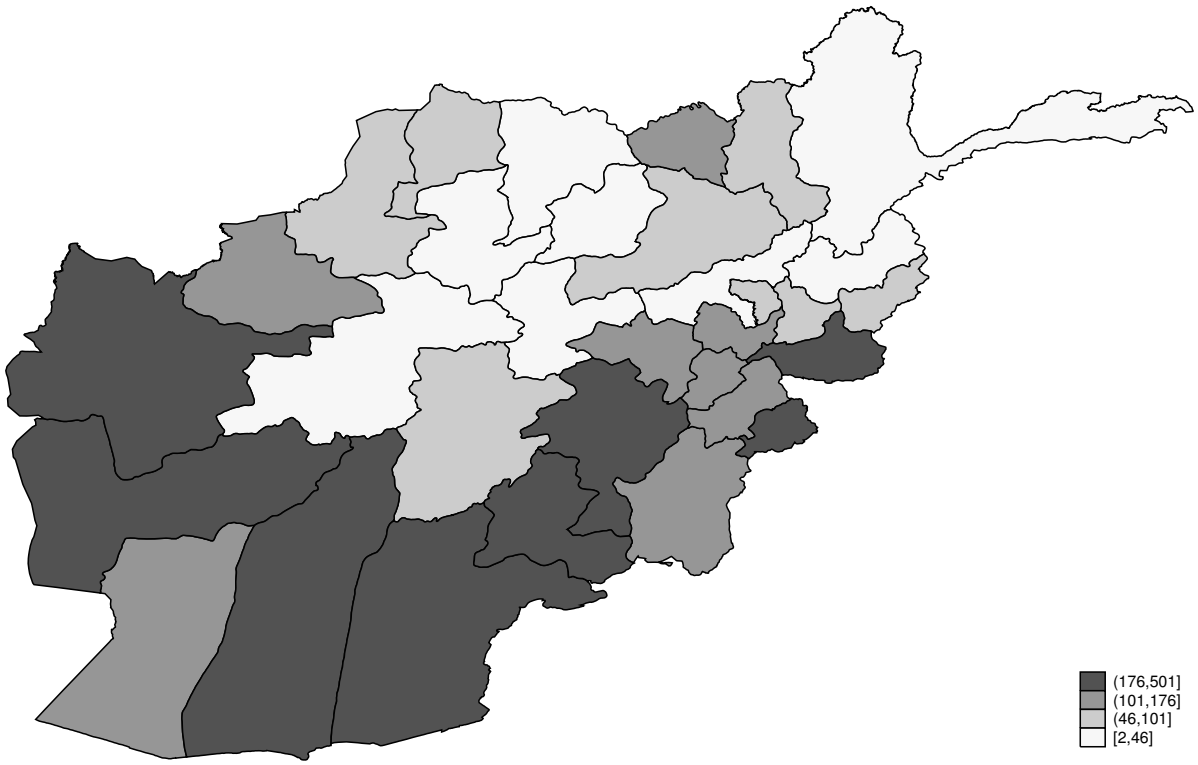
Figure 1: Monthly variation in drone strikes by the U.S. and terrorist attacks by the Taliban, January 2005 to September 2011



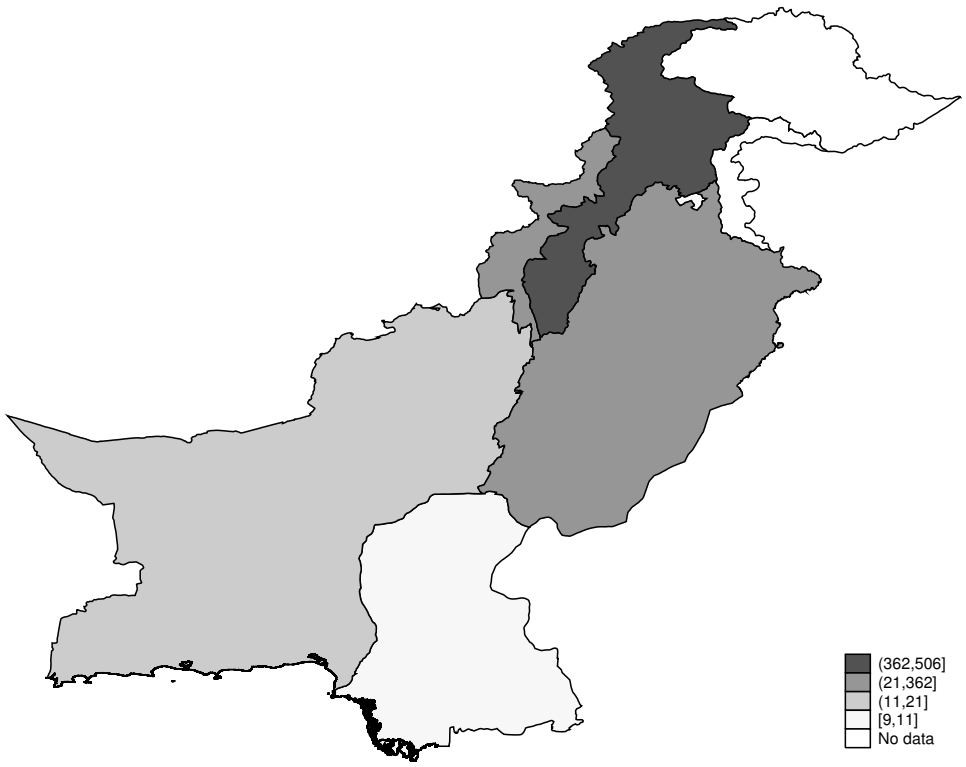
Source: Author calculations using data from the New America Foundation (drone strikes) and the Worldwide Incidents Tracking System of the National Counterterrorism Center (terrorist attacks). Shaded periods indicate Pakistan military offensives.

Figure 2: Spatial variation in terrorist attacks by the Taliban in Afghanistan, January 2005 to September 2011



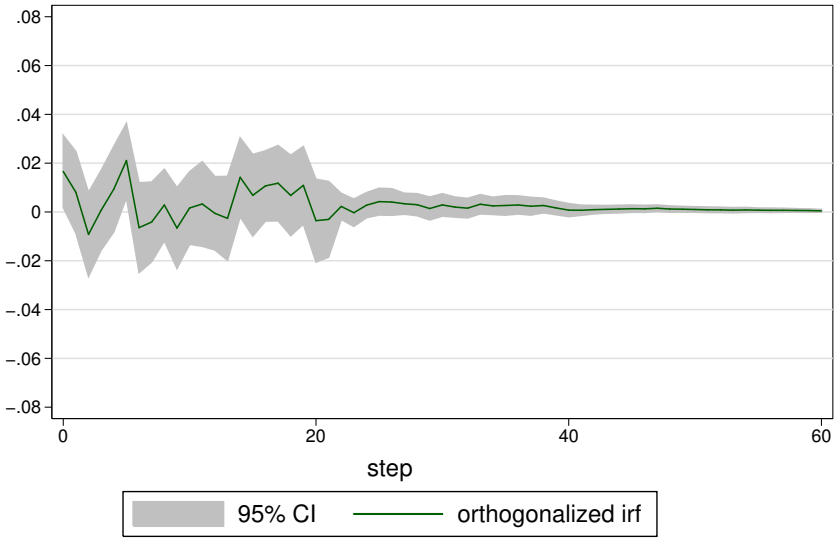
Source: Author calculations using terrorist attack data from the Worldwide Incidents Tracking System of the National Counterterrorism Center.

Figure 3: Spatial variation in terrorist attacks by the Taliban in Pakistan, January 2005 to September 2011

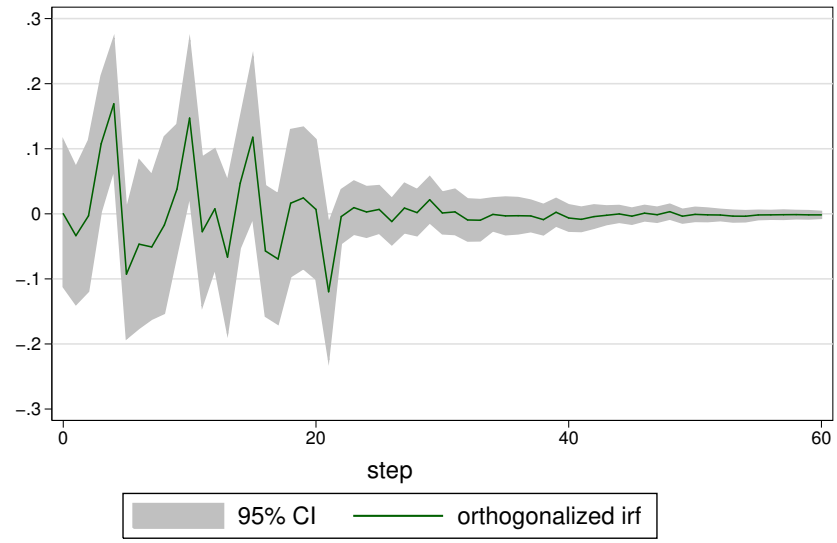


Source: Author calculations using terrorist attack data from the Worldwide Incidents Tracking System of the National Counterterrorism Center.

Figure 4: Impulse response functions for terrorist attacks by the Taliban in Afghanistan



(a) Incidence of attacks when the impulse variable is incidence of drone strikes

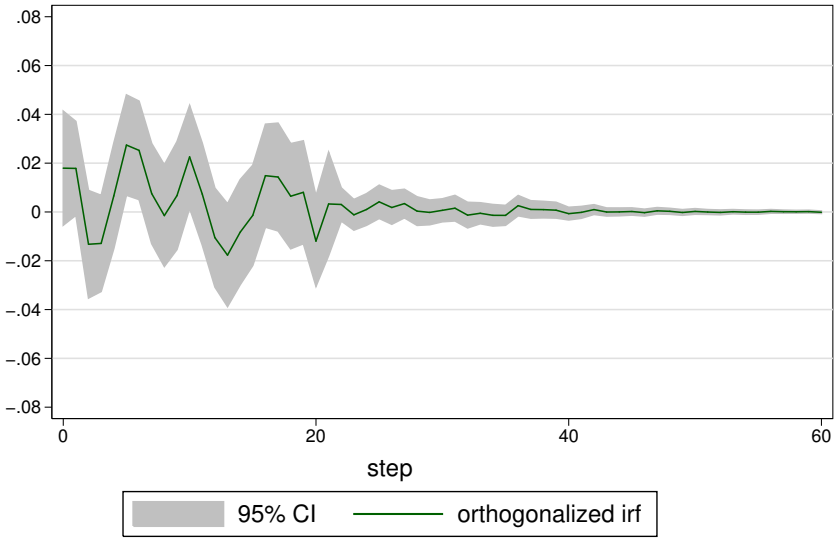


(b) Number of Attacks When the Impulse Variable is Number of Drone Strikes

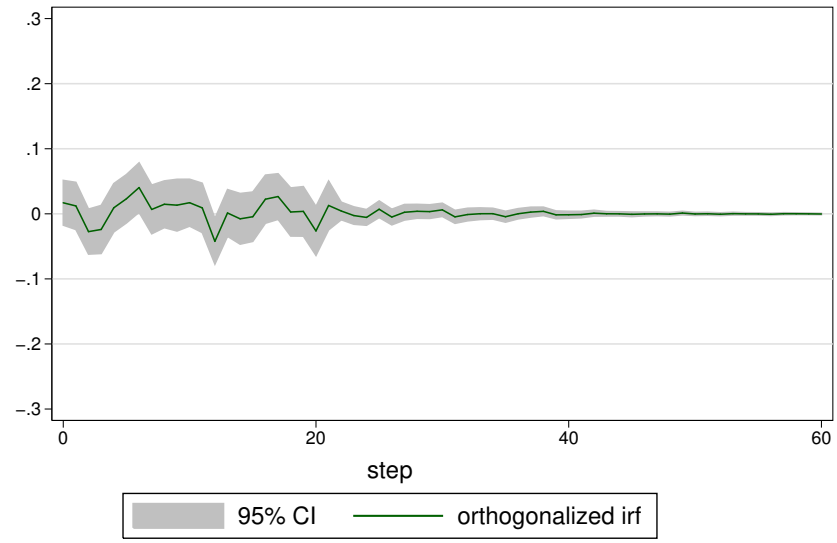
Source: Author calculations using data from the New America Foundation (drone strikes) and the Worldwide Incidents Tracking System of the National Counterterrorism Center (terrorist attacks).

Notes: Terrorist attacks are restricted to those where the perpetrator was identified as Taliban or Al-Qaeda. The sample is further restricted to 1,713 days between 1 January 2007 and 30 September 2011. Impulse response functions are generated by estimating a VAR model of daily drone strikes, terrorist attacks in Afghanistan and terrorist attacks in Pakistan with up to 21 lags and a set of exogenous variables specified in Section D from Tables 2 and 3 we well as day of week indicators. Confidence bands around the impulse response functions are constructed using the bootstrap.

Figure 5: Impulse response functions for terrorist attacks by the Taliban in Pakistan



(a) Incidence of Attacks when the Impulse Variable is Incidence of Drone Strikes



(b) Number of Attacks When the Impulse Variable is Number of Drone Strikes

Source: Author calculations using data from the New America Foundation (drone strikes) and the Worldwide Incidents Tracking System of the National Counterterrorism Center (terrorist attacks).

Notes: Terrorist attacks are restricted to those where the perpetrator was identified as Taliban or Al-Qaeda. The sample is further restricted to 1,713 days between 1 January 2007 and 30 September 2011. Impulse response functions are generated by estimating a VAR model of daily drone strikes, terrorist attacks in Afghanistan and terrorist attacks in Pakistan with up to 21 lags and a set of exogenous variables specified in Section D from Tables 2 and 3 we well as day of week indicators. Confidence bands around the impulse response functions are constructed using the bootstrap.

Table 1: Annual Number of Drone Strikes by the U.S. and Terrorist Attacks by the Taliban

Year	2005	2006	2007	2008	2009	2010	2011
Number of drone strikes	2	2	4	34	53	118	60
of which were							
Successful	2	0	0	11	9	14	3
Number of terrorist attacks in Afghanistan	264	511	636	691	860	1196	590
of which were							
Lethal	179	292	382	381	460	615	373
Suicide attacks	7	46	52	58	55	54	67
Number of terrorist attacks in Pakistan	3	18	95	273	290	158	98
of which were							
Lethal	3	14	50	128	149	84	69
Suicide attacks	0	0	8	20	26	26	23

Source: Author calculations using data from the New America Foundation (drone strikes) and the Worldwide Incidents Tracking System of the National Counterterrorism Center (terrorist attacks).

Notes: Terrorist attacks are restricted to those where the perpetrator was identified as Taliban or Al-Qaeda. Data for 2011 is through 30 September 2011 only. A successful drone strike is one in which a militant leader is reported killed. A lethal Taliban attack is one with at least one reported casualty.

Table 2: Daily Taliban Reaction Functions in Afghanistan

	Incidence of attacks		Number of attacks	
	Coeff.	(Std. Err.) or [p-value]	Coeff.	(Std. Err.) or [p-value]
A. Drone Strikes				
$t-1$	0.022	(0.026)	−0.081	(0.132)
$t-2$	−0.035	(0.027)	−0.001	(0.098)
$t-3$	0.001	(0.028)	0.263	(0.310)
$t-4$	0.033	(0.026)	0.379	(0.331)
$t-5$	0.067 ***	(0.021)	−0.262	(0.228)
$t-6$	−0.031	(0.026)	−0.107	(0.169)
$t-7$	−0.021	(0.029)	−0.112	(0.101)
$t-8$	0.011	(0.025)	−0.047	(0.144)
$t-9$	−0.019	(0.028)	0.089	(0.155)
$t-10$	−0.004	(0.023)	0.334	(0.555)
$t-11$	−0.008	(0.026)	−0.099	(0.156)
$t-12$	−0.003	(0.025)	0.019	(0.174)
$t-13$	< 0.001	(0.025)	−0.160	(0.157)
$t-14$	0.046 *	(0.023)	0.111	(0.125)
$t-15$	0.012	(0.024)	0.256	(0.360)
$t-16$	0.018	(0.026)	−0.167	(0.148)
$t-17$	0.030	(0.025)	−0.199	(0.175)
$t-18$	0.026	(0.022)	0.044	(0.150)
$t-19$	0.028	(0.024)	0.026	(0.149)
$t-20$	−0.029	(0.029)	0.007	(0.187)
$t-21$	−0.028	(0.023)	−0.313 *	(0.142)
Joint significance of 21 lags		[0.064]		[0.032]
Sum of coefficients	0.115	[0.216]	−0.020	[0.985]
B. Terrorist attacks by Taliban in Afghanistan (21 lags)				
Joint significance of 21 lags		[< 0.001]		[< 0.001]
Sum of coefficients	0.453	[< 0.001]	0.595	[< 0.001]
C. Terrorist attacks by Taliban in Pakistan (21 lags)				
Joint significance of 21 lags		[0.117]		[0.020]
Sum of coefficients	0.144	[0.039]	0.188	[0.455]
D. Additional controls				
Indicators for important periods:				
Post-Red Mosque Siege (03 Jul 07 and after)	0.060	(0.040)	0.350	(0.242)
Obama Administration (20 Jan 09 and after)	0.122 **	(0.051)	0.754 ***	(0.286)
Malakand accord (15 Feb 09 - 30 Apr 09)	−0.068	(0.060)	−0.471	(0.281)
Post-Bin Laden death (02 May 11 and after)	0.069	(0.036)	−0.037	(0.219)
Pakistan offensive 1 (01 Jan 08 - 31 May 08)	0.013	(0.043)	−0.007	(0.209)
Pakistan offensive 2 (23 Sep 08 - 31 Oct 08)	−0.062	(0.059)	0.128	(0.246)
Pakistan offensive 3 (01 May 09 - 31 May 09)	−0.020	(0.035)	−0.207	(0.385)
Pakistan offensive 4 (18 Oct 09 - 17 Dec 09)	< 0.001	(0.040)	−0.372	(0.297)
Other controls:				
Indicator for months with reduced fighting	−0.040	(0.023)	−0.204	(0.171)
1000s of U.S. troops deployed in Afghanistan	0.003 *	(0.002)	0.016	(0.009)
Time trend (days/365)	−0.128 **	(0.052)	−0.543 *	(0.262)

Source: Author calculations using data from the New America Foundation (drone strikes) and the Worldwide Incidents Tracking System of the National Counterterrorism Center (terrorist attacks).

Notes: Terrorist attacks are restricted to those where the perpetrator was identified as Taliban or Al-Qaeda. The sample is further restricted to 1,713 days between 1 January 2007 and 30 September 2011. Regressions include 21 lags of terrorist attacks by the Taliban in Afghanistan and in Pakistan (coefficients are not reported for brevity but are available from the authors on request). All regressions include day of week indicators. Months with traditionally reduced fighting in the Muslim calendar are Muharram, Dhu al-Qidah, Dhu al-Hijjah and Rajab. Variance-covariance matrices calculated using the Newey-West method. p-values are given in brackets. Standard errors are given in parentheses. For coefficients, $*$ indicates significance at the 5% level, $**$ indicates significance at the 2.5% level, and $***$ indicates significance at the 1% level.

Table 3: Daily Taliban Reaction Functions in Pakistan

	Incidence of attacks		Number of attacks	
	Coeff.	(Std. Err.) or [p-value]	Coeff.	(Std. Err.) or [p-value]
A. Drone Strikes				
$t-1$	0.053	(0.043)	0.023	(0.047)
$t-2$	−0.049	(0.035)	−0.069	(0.043)
$t-3$	−0.041	(0.035)	−0.048	(0.037)
$t-4$	0.024	(0.036)	0.031	(0.042)
$t-5$	0.090 ***	(0.033)	0.048	(0.037)
$t-6$	0.074 *	(0.033)	0.083	(0.048)
$t-7$	0.013	(0.035)	0.002	(0.040)
$t-8$	−0.011	(0.037)	0.043	(0.047)
$t-9$	0.017	(0.033)	0.031	(0.039)
$t-10$	0.071	(0.037)	0.024	(0.050)
$t-11$	0.007	(0.040)	0.000	(0.041)
$t-12$	−0.046	(0.034)	−0.113 ***	(0.037)
$t-13$	−0.060	(0.036)	0.016	(0.044)
$t-14$	−0.017	(0.032)	−0.011	(0.040)
$t-15$	−0.008	(0.034)	−0.020	(0.041)
$t-16$	0.041	(0.040)	0.046	(0.046)
$t-17$	0.044	(0.038)	0.043	(0.051)
$t-18$	0.021	(0.036)	−0.003	(0.039)
$t-19$	0.031	(0.035)	0.001	(0.045)
$t-20$	−0.046	(0.042)	−0.053	(0.041)
$t-21$	0.011	(0.032)	0.032	(0.051)
Joint significance of 21 lags		[0.011]		[0.047]
Sum of coefficients	0.221	[0.062]	0.109	[0.445]
B. Terrorist attacks by the Taliban in Afghanistan (21 lags)				
Joint significance of 21 lags		[0.217]		[0.002]
Sum of coefficients	−0.072	[0.341]	0.040	[0.096]
C. Terrorist attacks by the Taliban in Pakistan (21 lags)				
Joint significance of 21 lags		[0.007]		[< 0.001]
Sum of coefficients	0.120	[0.187]	0.217	[0.065]
D. Additional controls				
Indicators for important periods:				
Post-Red Mosque Siege (03 Jul 07 and after)	−0.052	(0.066)	−0.167	(0.104)
Obama Administration (20 Jan 09 and after)	−0.118	(0.061)	−0.388 ***	(0.148)
Malakand accord (15 Feb 09 - 30 Apr 09)	0.056	(0.056)	0.138	(0.132)
Post-Bin Laden death (02 May 11 and after)	−0.093	(0.062)	−0.234 **	(0.099)
Pakistan offensive 1 (01 Jan 08 - 31 May 08)	−0.185 ***	(0.053)	−0.284 ***	(0.088)
Pakistan offensive 2 (23 Sep 08 - 31 Oct 08)	−0.035	(0.089)	−0.183	(0.145)
Pakistan offensive 3 (01 May 09 - 31 May 09)	0.208 ***	(0.060)	0.669	(0.447)
Pakistan offensive 4 (18 Oct 09 - 17 Dec 09)	−0.121 ***	(0.044)	−0.179 *	(0.083)
Other controls:				
Indicator for months with reduced fighting	0.011	(0.027)	0.043	(0.048)
1000s of U.S. troops deployed in Afghanistan	−0.011 ***	(0.002)	−0.024 ***	(0.005)
Time trend (days/365)	0.299 ***	(0.069)	0.681 ***	(0.145)

Source: Author calculations using data from the New America Foundation (drone strikes) and the Worldwide Incidents Tracking System of the National Counterterrorism Center (terrorist attacks).

Notes: Terrorist attacks are restricted to those where the perpetrator was identified as Taliban or Al-Qaeda. The sample is further restricted to 1,713 days between 1 January 2007 and 30 September 2011. Regressions include up to 21 lags of terrorist attacks by the Taliban in Afghanistan and in Pakistan (coefficients are not reported for brevity but are available from the authors on request). All regressions include day of week indicators. Months with traditionally reduced fighting in the Muslim calendar are Muharram, Dhu al-Qidah, Dhu al-Hijjah and Rajab. Variance-covariance matrices calculated using the Newey-West method. p-values are given in brackets. Standard errors are given in parentheses. For coefficients, $*$ indicates significance at the 5% level, $**$ indicates significance at the 2.5% level, and $***$ indicates significance at the 1% level.

Table 4: Daily Drone Strike Reaction Functions

	Incidence of attacks		Number of attacks	
	Coeff.	(Std. Err.) or [p-value]	Coeff.	(Std. Err.) or [p-value]
A. Drone Strikes				
Joint significance of 21 lags		[0.124]		[0.006]
Sum of coefficients	0.319	[0.041]	0.255	[0.042]
B. Terrorist attacks by the Taliban in Afghanistan (21 lags)				
$t-1$	0.017	(0.325)	0.002	(0.004)
$t-2$	−0.039 *	(0.049)	0.004	(0.003)
$t-3$	−0.010	(0.659)	−0.003	(0.004)
$t-4$	0.030	(0.133)	0.012	(0.006)
$t-5$	−0.018	(0.368)	−0.006	(0.004)
$t-6$	0.004	(0.878)	−0.005	(0.003)
$t-7$	0.005	(0.823)	0.008 *	(0.003)
$t-8$	−0.036	(0.112)	0.005	(0.007)
$t-9$	−0.007	(0.750)	0.004	(0.004)
$t-10$	−0.007	(0.700)	0.005	(0.005)
$t-11$	−0.018	(0.325)	−0.007	(0.004)
$t-12$	−0.004	(0.810)	−0.004	(0.003)
$t-13$	−0.027	(0.218)	−0.004	(0.004)
$t-14$	0.042 *	(0.035)	0.010	(0.007)
$t-15$	0.015	(0.418)	−0.006	(0.004)
$t-16$	−0.006	(0.745)	< 0.001	(0.004)
$t-17$	−0.001	(0.963)	−0.001	(0.004)
$t-18$	0.062 ***	(0.000)	0.014 ***	(0.005)
$t-19$	0.023	(0.298)	0.001	(0.005)
$t-20$	−0.009	(0.635)	0.012 *	(0.005)
$t-21$	0.026	(0.218)	−0.003	(0.004)
Joint significance of 21 lags		[0.030]		[< 0.001]
Sum of coefficients	0.041	[0.048]	0.037	[0.085]
C. Terrorist attacks by the Taliban in Pakistan (21 lags)				
$t-1$	0.015	(0.431)	0.001	(0.014)
$t-2$	−0.006	(0.752)	0.007	(0.013)
$t-3$	−0.013	(0.431)	−0.019	(0.010)
$t-4$	−0.036	(0.050)	−0.041 ***	(0.011)
$t-5$	−0.006	(0.663)	0.020	(0.014)
$t-6$	−0.002	(0.904)	−0.008	(0.013)
$t-7$	0.016	(0.297)	0.027 *	(0.013)
$t-8$	0.013	(0.465)	−0.003	(0.012)
$t-9$	0.035 **	(0.016)	0.025 **	(0.011)
$t-10$	0.001	(0.967)	0.020	(0.014)
$t-11$	0.018	(0.275)	0.006	(0.015)
$t-12$	0.005	(0.761)	0.022	(0.014)
$t-13$	−0.006	(0.717)	−0.018	(0.014)
$t-14$	0.006	(0.760)	0.002	(0.013)
$t-15$	0.016	(0.394)	0.020	(0.013)
$t-16$	−0.003	(0.886)	−0.010	(0.015)
$t-17$	−0.006	(0.722)	< 0.001	(0.012)
$t-18$	−0.026	(0.173)	−0.033 ***	(0.012)
$t-19$	−0.003	(0.851)	−0.002	(0.011)
$t-20$	< 0.001	(< 0.001)	0.002	(0.014)
$t-21$	−0.001	(0.920)	−0.003	(0.011)
Joint significance of 21 lags		[0.294]		[0.004]
Sum of coefficients	0.016	[0.813]	0.014	[0.728]

continued

Table 4: Daily Drone Strike Reaction Functions

	Incidence of attacks		Number of attacks	
	Coeff.	(Std. Err.) or [p-value]	Coeff.	(Std. Err.) or [p-value]
D. Additional controls				
Indicators for important periods:				
Post-Red Mosque Siege (03 Jul 07 and after)	−0.024	(0.284)	−0.064 *	(0.031)
Obama Administration (20 Jan 09 and after)	0.034	(0.423)	0.033	(0.061)
Malakand accord (15 Feb 09 - 30 Apr 09)	−0.007	(0.844)	0.014	(0.052)
Post-Bin Laden death (02 May 11 and after)	−0.052	(0.242)	−0.048	(0.061)
Pakistan offensive 1 (01 Jan 08 - 31 May 08)	0.002	(0.929)	0.028	(0.028)
Pakistan offensive 2 (23 Sep 08 - 31 Oct 08)	0.085	(0.061)	0.134 *	(0.061)
Pakistan offensive 3 (01 May 09 - 31 May 09)	−0.062	(0.205)	−0.088	(0.058)
Pakistan offensive 4 (18 Oct 09 - 17 Dec 09)	−0.075 **	(0.014)	−0.130 ***	(0.042)
Other controls:				
Indicator for months with reduced fighting	< 0.001 ***	(< 0.001)	< 0.001 ***	(< 0.001)
1000s of U.S. troops deployed in Afghanistan	< −0.001	(0.001)	−0.001	(0.002)
Time trend (days/365)	0.042	(0.035)	0.067	(0.048)

Source: Author calculations using data from the New America Foundation (drone strikes) and the Worldwide Incidents Tracking System of the National Counterterrorism Center (terrorist attacks).

Notes: Terrorist attacks are restricted to those where the perpetrator was identified as Taliban or Al-Qaeda. The sample is further restricted to 1,713 days between 1 January 2007 and 30 September 2011. Regressions include up to 21 lags of terrorist attacks by the Taliban in Afghanistan and in Pakistan (coefficients are not reported for brevity but are available from the authors on request). All regressions include day of week indicators. Months with traditionally reduced fighting in the Muslim calendar are Muharram, Dhu al-Qidah, Dhu al-Hijjah and Rajab. Variance-covariance matrices calculated using the Newey-West method. p-values are given in brackets. Standard errors are given in parentheses. For coefficients, $*$ indicates significance at the 5% level, $**$ indicates significance at the 2.5% level, and $***$ indicates significance at the 1% level.

Table 5: Robustness Tests: Lag Structures

Daily Taliban Reaction Functions in Afghanistan

Lags	Incidence of Attacks		Number of Attacks	
	Joint	Sum	Joint	Sum
(7,7,7)	0.052	0.606	0.528	0.591
(14,14,14)	0.209	0.326	0.603	0.654
(21,21,21)	0.064	0.216	0.032	0.985
(28,28,28)	0.035	0.581	0.001	0.598
(35,35,35)	0.052	0.895	< 0.001	0.118
(42,42,42)	0.040	0.807	< 0.001	0.031
(49,49,49)	0.049	0.766	< 0.001	0.006
(56,56,56)	0.008	0.549	< 0.001	0.010
(63,63,63)	0.008	0.738	< 0.001	0.004
(70,70,70)	< 0.001	0.926	< 0.001	0.005

Daily Taliban Reaction Functions in Pakistan

Lags	Incidence of Attacks		Number of Attacks	
	Joint	Sum	Joint	Sum
(7,7,7)	0.003	0.099	0.112	0.459
(14,14,14)	0.010	0.215	0.124	0.576
(21,21,21)	0.011	0.062	0.047	0.445
(28,28,28)	0.000	0.026	0.006	0.105
(35,35,35)	< 0.001	0.010	0.026	0.030
(42,42,42)	< 0.001	0.011	< 0.001	0.006
(49,49,49)	< 0.001	0.013	< 0.001	0.010
(56,56,56)	< 0.001	0.027	< 0.001	0.042
(63,63,63)	< 0.001	0.005	< 0.001	0.013
(70,70,70)	< 0.001	0.007	< 0.001	0.003

Source: Author calculations using data from the New America Foundation (drone strikes) and the Worldwide Incidents Tracking System of the National Counterterrorism Center (terrorist attacks).

Notes: Entries in the table are p-values. "Joint" indicates the p-value for a χ^2 test for the joint significance of the relevant lags. "Sum" indicates the p-value for a χ^2 test that the sum of the coefficients is equal to zero. Terrorist attacks are restricted to those where the perpetrator was identified as Taliban or Al-Qaeda. The sample is further restricted to $1,713$ days between 1 January 2007 to 30 September 2011. Tests of significance are carried out on OLS regressions of daily terrorist attacks in Afghanistan and Pakistan on lags of drone strikes, terrorist attacks in Afghanistan and terrorist attacks in Pakistan. Regressions are estimated with the given lag length. Each regression includes the controls specified in (D) in tables 2 and 3 as well as day of week indicators. Tests based on heteroscedasticity/autocorrelation corrected Newey-West variance-covariacne matrices.

Table 6: Robustness Tests: Time Aggregation

Taliban Reaction Functions in Afghanistan		
Time aggregation	Number of Attacks	
	Joint	Sum
Daily, 21 lags	0.032	0.985
Weekly, 3 lags	0.204	0.803
Monthly, 1 lag	< 0.001	< 0.001

Taliban Reaction Functions in Pakistan		
Time aggregation	Number of Attacks	
	Joint	Sum
Daily, 21 lags	0.047	0.445
Weekly, 3 lags	0.360	0.281
Monthly, 1 lag	0.010	0.010

Source: Author calculations using data from the New America Foundation (drone strikes) and the Worldwide Incidents Tracking System of the National Counterterrorism Center (terrorist attacks).

Notes: Entries in table are p-values. "Joint" indicates the p-value for a χ^2 test for the joint significance of the relevant lags. "Sum" indicates the p-value for a χ^2 test that the sum of the coefficients is equal to zero. Terrorist attacks are restricted to those where the perpetrator was identified as Taliban or Al-Qaeda. The sample is further restricted to $1,713$ days between 1 January 2007 to 30 September 2011. Tests of significance are carried out on OLS regressions of terrorist attacks in Afghanistan and Pakistan on lags of drone strikes, terrorist attacks in Afghanistan and terrorist attacks in Pakistan. Regressions are estimated with the given time aggregation (daily, weekly and monthly) and lag length. Each regression includes the controls specified in (D) in tables 2 and 3 as well as a linear time trend in weeks/months. Tests based on heteroscedasticity/autocorrelation corrected Newey-West variance-covariacne matrices.

Table 7: Robustness Tests: The Effect of Drone Strikes on Lethal and Suicide Attacks

Daily Taliban Reaction Functions in Afghanistan				
Type of Taliban attack	Incidence of attacks		Number of attacks	
	Joint	Sum	Joint	Sum
All	0.064	0.216	0.032	0.985
Lethal attacks	0.195	0.704	0.332	0.514
Suicide attacks	0.252	0.354	0.581	0.526

Daily Taliban Reaction Functions in Pakistan				
Type of Taliban Attack	Incidence of Attacks		Number of Attacks	
	Joint	Sum	Joint	Sum
All	0.011	0.062	0.047	0.445
Lethal attacks	0.038	0.372	0.032	0.611
Suicide attacks	0.029	0.551	0.162	0.867

Source: Author calculations using data from the New America Foundation (drone strikes) and the Worldwide Incidents Tracking System of the National Counterterrorism Center (terrorist attacks).

Notes: Entries in the table are p-values. "Joint" indicates the p-value for a χ^2 test for the joint significance of the relevant lags. "Sum" indicates the p-value for a χ^2 test that the sum of the coefficients is equal to zero. Terrorist attacks are restricted to those where the perpetrator was identified as Taliban or Al-Qaeda. The sample is further restricted to $1,713$ days between 1 January 2007 to 30 September 2011. Tests of significance are carried out on OLS regressions of daily terrorist attacks in Afghanistan and Pakistan on twenty-one lags of drone strikes, terrorist attacks in Afghanistan and terrorist attacks in Pakistan. Regressions are estimated with terrorist attacks restricted to all, lethal or suicide terrorist attacks. Each regression includes the controls specified in (D) in tables 2 and 3 as well as a linear time trend and day of week indicators. Tests based on heteroscedasticity/autocorrelation corrected Newey-West variance-covariacne matrices.

Table 8: Daily Haqqani Reaction Functions

	Incidence of attacks		Number of attacks	
	Coeff.	(Std. Err.) or [p-value]	Coeff.	(Std. Err.) or [p-value]
A. Drone Strikes in Haqqani Base of Operations				
$t-1$	0.003	(0.036)	−0.032	(0.051)
$t-2$	−0.022	(0.038)	−0.093	(0.053)
$t-3$	0.013	(0.039)	0.071	(0.089)
$t-4$	0.021	(0.050)	0.087	(0.102)
$t-5$	−0.015	(0.038)	−0.078	(0.082)
$t-6$	−0.021	(0.043)	0.040	(0.069)
$t-7$	0.031	(0.044)	−0.015	(0.051)
$t-8$	0.083	(0.045)	0.061	(0.068)
$t-9$	0.023	(0.036)	0.115	(0.077)
$t-10$	0.026	(0.040)	0.158	(0.163)
$t-11$	−0.039	(0.047)	−0.078	(0.084)
$t-12$	0.033	(0.046)	−0.006	(0.074)
$t-13$	0.017	(0.041)	−0.043	(0.048)
$t-14$	0.033	(0.041)	0.040	(0.057)
$t-15$	−0.070	(0.048)	0.085	(0.129)
$t-16$	−0.030	(0.043)	−0.061	(0.065)
$t-17$	−0.083 *	(0.040)	−0.111	(0.062)
$t-18$	−0.021	(0.043)	−0.061	(0.057)
$t-19$	−0.050	(0.042)	−0.046	(0.061)
$t-20$	0.006	(0.041)	−0.025	(0.061)
$t-21$	−0.005	(0.036)	−0.041	(0.065)
Joint significance of 21 lags		[0.242]		[0.867]
Sum of coefficients	−0.066	[0.648]	−0.034	[0.880]
B. Terrorist Attacks by Taliban in Haqqani Areas of Combat Operations (21 lags)				
Joint significance of 21 lags		[< 0.001]		[0.867]
Sum of coefficients	0.065	[< 0.001]	0.622	[0.879]
D. Additional Controls				
Indicators for important periods:				
Post-Red Mosque Siege (03 Jul 07 and after)	0.058	(0.061)	0.154	(0.134)
Obama Administration (20 Jan 09 and after)	0.047	(0.053)	0.134	(0.106)
Malakand accord (15 Feb 09 - 30 Apr 09)	−0.057	(0.074)	−0.123	(0.158)
Post-Bin Laden death (02 May 11 and after)	−0.009	(0.051)	−0.011	(0.085)
Pakistan offensive 1 (01 Jan 08 - 31 May 08)	−0.056	(0.051)	−0.074	(0.108)
Pakistan offensive 2 (23 Sep 08 - 31 Oct 08)	−0.033	(0.052)	−0.016	(0.108)
Pakistan offensive 3 (01 May 09 - 31 May 09)	−0.018	(0.057)	0.037	(0.152)
Pakistan offensive 4 (18 Oct 09 - 17 Dec 09)	−0.080	(0.045)	−0.134 *	(0.079)
Other controls:				
Indicator for months with reduced fighting	−0.066 ***	(0.024)	−0.140 ***	(0.050)
1000s of U.S. troops deployed in Afghanistan	0.001	(0.002)	0.002	(0.003)
Time trend (days/365)	−0.054	(0.050)	−0.142	(0.098)

Source: Author calculations using data from the New America Foundation (drone strikes) and the Worldwide Incidents Tracking System of the National Counterterrorism Center (terrorist attacks).

Notes: Terrorist attacks are restricted to those where the perpetrator was identified as Taliban or Al-Qaeda. Haqqani base of operations are all areas in North Waziristan, Pakistan. Haqqani areas of combat operations are all areas in the states of Khost, Paktia, Paktika, Ghazni, Logar, Wardak, and Kabul (in Afghanistan). The sample is also restricted to 1,713 days between 1 January 2007 and 30 September 2011. Regressions include up to 21 lags of terrorist attacks in the Haqqani areas of combat operations (coefficients are not reported for brevity but are available from the authors on request). All regressions include day of week indicators. Months with traditionally reduced fighting in the Muslim calendar are Muharram, Dhu al-Qidah, Dhu al-Hijjah and Rajab. Variance-covariance matrices calculated using the Newey-West method. p-values are given in brackets. Standard errors are given in parentheses. For coefficients, $*$ indicates significance at the 5% level, $**$ indicates significance at the 2.5% level, and $***$ indicates significance at the 1% level.

Table 9: Daily Mehsud Reaction Functions

	Incidence of attacks		Number of attacks	
	Coeff.	(Std. Err.) or [p-value]	Coeff.	(Std. Err.) or [p-value]
A. Drone Strikes in Mehsud Base of Operations				
$t-1$	−0.005	(0.057)	−0.023	(0.057)
$t-2$	−0.030	(0.051)	−0.036	(0.041)
$t-3$	0.055	(0.047)	0.050	(0.048)
$t-4$	0.012	(0.059)	0.010	(0.055)
$t-5$	0.051	(0.050)	0.113	(0.066)
$t-6$	0.059	(0.052)	0.103	(0.066)
$t-7$	−0.034	(0.055)	−0.035	(0.052)
$t-8$	−0.063	(0.053)	−0.035	(0.057)
$t-9$	0.065	(0.056)	0.032	(0.055)
$t-10$	0.099	(0.060)	0.068	(0.055)
$t-11$	0.127 **	(0.054)	0.129	(0.082)
$t-12$	−0.066	(0.046)	−0.072	(0.040)
$t-13$	0.079	(0.060)	0.039	(0.044)
$t-14$	−0.116 ***	(0.043)	−0.119 ***	(0.033)
$t-15$	−0.025	(0.051)	−0.075 *	(0.035)
$t-16$	−0.028	(0.053)	−0.028	(0.049)
$t-17$	−0.002	(0.056)	−0.016	(0.046)
$t-18$	−0.052	(0.047)	−0.053	(0.041)
$t-19$	−0.037	(0.058)	−0.027	(0.053)
$t-20$	−0.013	(0.061)	−0.015	(0.051)
$t-21$	0.019	(0.055)	−0.008	(0.050)
Joint significance of 21 lags		[0.004]		[< 0.001]
Sum of coefficients	0.094	[0.686]	0.002	[0.992]
B. Terrorist Attacks by Taliban in Mehsud Areas of Combat Operations (21 lags)				
Joint significance of 21 lags		[0.003]		[< 0.001]
Sum of coefficients	0.218	[0.010]	0.281	[0.010]
D. Additional Controls				
Indicators for important periods:				
Post-Red Mosque Siege(03 Jul 07 and after)	−0.033	(0.053)	−0.053	(0.065)
Obama Administration (20 Jan 09 and after)	−0.047	(0.050)	−0.107 ***	(0.069)
Malakand accord (15 Feb 09 - 30 Apr 09)	0.044	(0.060)	0.049	(0.081)
Post-Bin Laden death (02 May 11 and after)	−0.102 ***	(0.037)	−0.141	(0.050)
Pakistan offensive 1 (01 Jan 08 - 31 May 08)	−0.060	(0.038)	−0.066	(0.058)
Pakistan offensive 2 (23 Sep 08 - 31 Oct 08)	−0.084	(0.052)	−0.138 *	(0.065)
Pakistan offensive 3 (01 May 09 - 31 May 09)	0.072	(0.080)	0.071	(0.082)
Pakistan offensive 4 (18 Oct 09 - 17 Dec 09)	−0.085 **	(0.034)	−0.082	(0.051)
Other controls:				
Indicator for months with reduced fighting	0.010 ***	(0.019)	0.019	(0.028)
1000s of U.S. troops deployed in Afghanistan	−0.007 ***	(0.002)	−0.008 ***	(0.002)
Time trend (days/365)	0.176 ***	(0.056)	0.240 ***	(0.073)

Source: Author calculations using data from the New America Foundation (drone strikes) and the Worldwide Incidents Tracking System of the National Counterterrorism Center (terrorist attacks).

Notes: Terrorist attacks are restricted to those where the perpetrator was identified as Taliban or Al-Qaeda. Mehsud base of operations are all areas in South Waziristan, Pakistan. Mehsud areas of combat operations are all areas in the Federally Administered Tribal Areas (FATA) in Pakistan. The sample is also restricted to 1,713 days between 1 January 2007 and 30 September 2011. Regressions include up to 21 lags of terrorist attacks in Mehsud areas of combat operations (coefficients not reported for brevity but are available from the authors on request). All regressions include day of week indicators. Months with traditionally reduced fighting in the Muslim calendar are Muharram, Dhu al-Qidah, Dhu al-Hijjah and Rajab. Variance-covariance matrices calculated using the Newey-West method. p-values are given in brackets. Standard errors are given in parentheses. For coefficients, $*$ indicates significance at the 5% level, $**$ indicates significance at the 2.5% level, and $***$ indicates significance at the 1% level.

Table 10: Daily Taliban Reaction Functions in Afghanistan to Successful and Unsuccessful Drone Strikes

	Incidence of attacks		**Number of attacks**	
	Coeff.	(Std. Err.) or [p-value]	Coeff.	(Std. Err.) or [p-value]
A1. Successful Drone Strikes (21 lags)				
$t-1$	0.010	(0.078)	−0.175	(0.247)
$t-2$	0.031	(0.054)	0.317	(0.314)
$t-3$	−0.009	(0.058)	−0.076	(0.313)
$t-4$	0.088 *	(0.042)	0.036	(0.221)
$t-5$	0.107 ***	(0.031)	0.034	(0.265)
$t-6$	0.019	(0.057)	0.123	(0.266)
$t-7$	−0.028	(0.057)	0.326	(0.348)
$t-8$	−0.045	(0.059)	0.569	(0.374)
$t-9$	−0.047	(0.065)	0.201	(0.355)
$t-10$	−0.067	(0.062)	−0.436	(0.307)
$t-11$	−0.045	(0.055)	−0.317	(0.232)
$t-12$	0.003	(0.060)	−0.104	(0.301)
$t-13$	−0.042	(0.056)	−0.463 *	(0.225)
$t-14$	0.035	(0.058)	0.203	(0.351)
$t-15$	0.054	(0.053)	0.098	(0.344)
$t-16$	0.084	(0.054)	0.115	(0.266)
$t-17$	0.042	(0.053)	0.042	(0.287)
$t-18$	0.077	(0.050)	0.372	(0.265)
$t-19$	0.041	(0.055)	0.081	(0.335)
$t-20$	−0.020	(0.064)	0.023	(0.291)
$t-21$	−0.077	(0.063)	−0.104	(0.323)
Joint significance of 21 lags		[0.161]		[0.101]
Sum of coefficients	0.210	[0.403]	0.864	[0.568]
A2. Unsuccessful Drone Strikes (21 lags)				
$t-1$	0.018	(0.026)	−0.053	(0.139)
$t-2$	−0.053	(0.031)	−0.039	(0.105)
$t-3$	0.003	(0.030)	0.308	(0.359)
$t-4$	0.020	(0.029)	0.420	(0.367)
$t-5$	0.053 **	(0.023)	−0.329	(0.253)
$t-6$	−0.048	(0.028)	−0.155	(0.193)
$t-7$	−0.009	(0.031)	−0.181	(0.108)
$t-8$	0.032	(0.025)	−0.139	(0.183)
$t-9$	−0.027	(0.031)	0.091	(0.171)
$t-10$	0.017	(0.023)	0.449	(0.622)
$t-11$	0.001	(0.027)	−0.064	(0.171)
$t-12$	0.000	(0.026)	0.068	(0.210)
$t-13$	0.002	(0.029)	−0.103	(0.168)
$t-14$	0.044	(0.026)	0.098	(0.135)
$t-15$	0.001	(0.026)	0.266	(0.407)
$t-16$	0.007	(0.027)	−0.215	(0.182)
$t-17$	0.022	(0.028)	−0.236	(0.192)
$t-18$	0.017	(0.024)	0.008	(0.169)
$t-19$	0.020	(0.028)	0.018	(0.152)
$t-20$	−0.024	(0.031)	−0.002	(0.200)
$t-21$	−0.014	(0.026)	−0.335 **	(0.136)
Joint significance of 21 lags		[0.190]		[0.011]
Sum of coefficients	0.081	[0.379]	−0.123	[0.915]

continued

Table 10: Daily Taliban Reaction Functions in Afghanistan to Successful and Unsuccessful Drone Strikes

	Incidence of attacks		**Number of attacks**	
	Coeff.	(Std. Err.) or [p-value]	Coeff.	(Std. Err.) or [p-value]
B. Terrorist attacks by Taliban in Afghanistan (21 lags)				
Joint significance of 21 lags		[< 0.001]		[< 0.001]
Sum of coefficients	0.462	[< 0.001]	0.599	[< 0.001]
C. Terrorist attacks by Taliban in Pakistan (21 lags)				
Joint significance of 21 lags		[0.163]		[0.051]
Sum of coefficients	0.147	[0.042]	0.440	[0.440]
D. Additional controls				
Indicators for important periods:				
Post-Red Mosque Siege (03 Jul 07 and after)	0.061	(0.041)	0.367	(0.239)
Obama Administration (20 Jan 09 and after)	0.123 **	(0.051)	0.761 ***	(0.287)
Malakand accord (15 Feb 09 - 30 Apr 09)	−0.060	(0.061)	−0.415	(0.328)
Post-Bin Laden death (02 May 11 and after)	0.070	(0.037)	−0.011	(0.230)
Pakistan offensive 1 (01 Jan 08 - 31 May 08)	0.015	(0.044)	0.014	(0.224)
Pakistan offensive 2 (23 Sep 08 - 31 Oct 08)	−0.055	(0.057)	0.126	(0.242)
Pakistan offensive 3 (01 May 09 - 31 May 09)	−0.018	(0.035)	−0.219	(0.388)
Pakistan offensive 4 (18 Oct 09 - 17 Dec 09)	0.001	(0.042)	−0.328	(0.293)
Other controls:				
Indicator for months with reduced fighting	−0.040	(0.023)	−0.208	(0.172)
1000s of U.S. troops deployed in Afghanistan	0.004 *	(0.002)	0.018	(0.011)
Time trend (days/365)	−0.133 **	(0.055)	−0.606 *	(0.297)

Source: Author calculations using data from the New America Foundation (drone strikes) and the Worldwide Incidents Tracking System of the National Counterterrorism Center (terrorist attacks).

Notes: Terrorist attacks are restricted to those where the perpetrator was identified as Taliban or Al-Qaeda. The sample is further restricted to 1,713 days between 1 January 2007 and 30 September 2011. Regressions include 21 lags of terrorist attacks by the Taliban in Afghanistan and in Pakistan (coefficients are not reported for brevity but are available from the authors on request). All regressions include day of week indicators. Months with traditionally reduced fighting in the Muslim calendar are Muharram, Dhu al-Qidah, Dhu al-Hijjah and Rajab. Variance-covariance matrices calculated using the Newey-West method. p-values are given in brackets. Standard errors are given in parentheses. For coefficients, $*$ indicates significance at the 5% level, $**$ indicates significance at the 2.5% level, and $***$ indicates significance at the 1% level.

Table 11: Daily Taliban Reaction Functions in Pakistan to Successful and Unsuccessful Drone Strikes

	Incidence of attacks		**Number of attacks**	
	Coeff.	(Std. Err.) or [p-value]	Coeff.	(Std. Err.) or [p-value]
A1. Successful Drone Strikes (21 lags)				
$t-1$	0.079	(0.081)	0.160	(0.111)
$t-2$	0.041	(0.085)	−0.103	(0.106)
$t-3$	−0.177 **	(0.072)	−0.178	(0.143)
$t-4$	−0.033	(0.078)	−0.083	(0.135)
$t-5$	0.037	(0.073)	0.144	(0.153)
$t-6$	0.027	(0.080)	−0.028	(0.156)
$t-7$	0.048	(0.076)	0.115	(0.148)
$t-8$	0.020	(0.089)	0.045	(0.145)
$t-9$	−0.089	(0.070)	−0.112	(0.144)
$t-10$	0.115	(0.086)	0.206	(0.131)
$t-11$	−0.090	(0.081)	0.068	(0.171)
$t-12$	0.076	(0.077)	−0.062	(0.109)
$t-13$	0.059	(0.078)	0.150	(0.168)
$t-14$	−0.135 *	(0.065)	−0.283 **	(0.122)
$t-15$	0.050	(0.076)	−0.039	(0.120)
$t-16$	0.011	(0.071)	0.111	(0.160)
$t-17$	0.074	(0.084)	0.047	(0.177)
$t-18$	0.054	(0.089)	−0.020	(0.147)
$t-19$	−0.055	(0.086)	−0.250 *	(0.126)
$t-20$	0.003	(0.089)	0.009	(0.142)
$t-21$	0.090	(0.077)	0.125	(0.154)
Joint significance of 21 lags		[0.191]		[0.013]
Sum of coefficients	0.203	[0.538]	0.022	[0.969]
A2. Unsuccessful Drone Strikes (21 lags)				
$t-1$	0.043	(0.044)	0.002	(0.050)
$t-2$	−0.059	(0.036)	−0.064	(0.044)
$t-3$	−0.011	(0.039)	−0.024	(0.041)
$t-4$	0.032	(0.040)	0.047	(0.047)
$t-5$	0.097 ***	(0.037)	0.041	(0.039)
$t-6$	0.076 *	(0.037)	0.099 *	(0.046)
$t-7$	0.006	(0.035)	−0.015	(0.038)
$t-8$	−0.013	(0.037)	0.043	(0.047)
$t-9$	0.042	(0.036)	0.047	(0.040)
$t-10$	0.060	(0.041)	−0.010	(0.057)
$t-11$	0.026	(0.041)	−0.004	(0.037)
$t-12$	−0.075 *	(0.037)	−0.121 ***	(0.038)
$t-13$	−0.087 **	(0.036)	−0.002	(0.043)
$t-14$	0.019	(0.037)	0.024	(0.046)
$t-15$	−0.025	(0.039)	−0.019	(0.046)
$t-16$	0.047	(0.043)	0.041	(0.047)
$t-17$	0.038	(0.044)	0.052	(0.052)
$t-18$	0.023	(0.040)	−0.002	(0.042)
$t-19$	0.048	(0.037)	0.027	(0.048)
$t-20$	−0.065	(0.045)	−0.068	(0.042)
$t-21$	−0.016	(0.036)	0.017	(0.057)
Joint significance of 21 lags		[0.001]		[0.037]
Sum of coefficients	0.208	[0.112]	0.113	[0.472]

continued

Table 11: Daily Taliban Reaction Functions in Pakistan to Successful and Unsuccessful Drone Strikes

	Incidence of attacks		**Number of attacks**	
	Coeff.	(Std. Err.) or [p-value]	Coeff.	(Std. Err.) or [p-value]
B. Terrorist attacks by Taliban in Afghanistan (21 lags)				
Joint significance of 21 lags		[0.204]		[0.002]
Sum of coefficients	−0.073	[0.354]	0.040	[0.101]
C. Terrorist attacks by Taliban in Pakistan (21 lags)				
Joint significance of 21 lags		[0.009]		[< 0.001]
Sum of coefficients	0.129	[0.174]	0.218	[0.067]
D. Additional controls				
Indicators for important periods:				
Post-Red Mosque Siege (03 Jul 07 and after)	−0.050	(0.066)	−0.169	(0.104)
Obama Administration (20 Jan 09 and after)	−0.120 *	(0.061)	−0.391 ***	(0.146)
Malakand accord (15 Feb 09 - 30 Apr 09)	0.058	(0.055)	0.133	(0.141)
Post-Bin Laden death (02 May 11 and after)	−0.092	(0.062)	−0.236 **	(0.146)
Pakistan offensive 1 (01 Jan 08 - 31 May 08)	−0.183 ***	(0.052)	−0.285 ***	(0.088)
Pakistan offensive 2 (23 Sep 08 - 31 Oct 08)	−0.040	(0.086)	−0.183	(0.150)
Pakistan offensive 3 (01 May 09 - 31 May 09)	0.210 ***	(0.064)	0.671	(0.451)
Pakistan offensive 4 (18 Oct 09 - 17 Dec 09)	−0.117 **	(0.046)	−0.178 *	(0.087)
Other controls:				
Indicator for months with reduced fighting	0.058	(0.066)	−0.169	(0.104)
1000s of U.S. troops deployed in Afghanistan	−0.011 ***	(0.002)	−0.024 ***	(.005)
Time trend (days/365)	0.296 ***	(0.071)	0.686 ***	(0.146)

Source: Author calculations using data from the New America Foundation (drone strikes) and the Worldwide Incidents Tracking System of the National Counterterrorism Center (terrorist attacks).

Notes: Terrorist attacks are restricted to those where the perpetrator was identified as Taliban or Al-Qaeda. The sample is further restricted to 1,713 days between 1 January 2007 and 30 September 2011. Regressions include 21 lags of terrorist attacks by the Taliban in Afghanistan and in Pakistan (coefficients are not reported for brevity but are available from the authors on request). All regressions include day of week indicators. Months with traditionally reduced fighting in the Muslim calendar are Muharram, Dhu al-Qidah, Dhu al-Hijjah and Rajab. Variance-covariance matrices calculated using the Newey-West method. p-values are given in brackets. Standard errors are given in parentheses. For coefficients, $*$ indicates significance at the 5% level, $**$ indicates significance at the 2.5% level, and $***$ indicates significance at the 1% level.